

SWaP Reduction for Lost-Cost Star Tracker

Completed Technology Project (2016 - 2017)



Project Introduction

In the last two years, a low-cost star tracker has been developed for suborbital applications. Currently the system weighs ~9 lbm, uses ~16W and has a parts cost of ~\$12k/unit. The goal of this IRAD is to pursue a size weight and power (SWaP) and parts cost reduction for the star tracker to further its possible mission applications.

Currently the low-cost star tracker for suborbital applications consists of two parts: a tracker head and a processing unit. The size, weight, power and cost for both parts are detailed in the table below:

Tracker Head:

- Size = 5"x2.5"x2.5"
- Weight = 3.5 lbm
- Power = 4W
- Cost = \$6000

Processing Unit

- Size = 6"x6.6"x4.4"
- Weight = 5.3lbm
- Power = 12W
- Cost = \$6500

The objective of the project is to pursue a reduction in size, weight and power for both the tracker as a whole, with a primary focusing on the processing unit. The objectives will be:

- Market survey looking at among other things, smart cameras (processor and camera head combined), newer cameras with lower power usage and miniature low power embedded computers and a direction selected
- Prototype hardware purchased
- Star tracker algorithms ported
- Night sky testing of prototype star tracker
- TVAC testing of new hardware
- Vibration testing of new hardware

The goal is to reduce the SWaP and cost by half for the tracker as a whole getting the total weight to less than 5lbm, total power to less than 8W and total parts cost to less than \$6k. The focus will still be on interchangeable COTS components where possible to maintain a simple and easily upgradable system which is robust to parts obsolescence.

Anticipated Benefits



, Current Processing Computer

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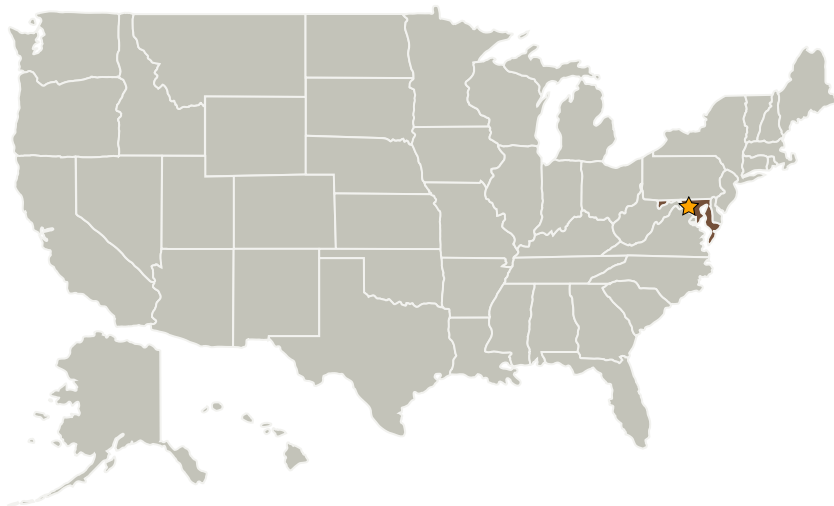
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Low-cost star tracker will enable better attitude estimation and control at a lower cost for suborbital missions. The price allows for missions that could afford this level of pointing to achieve it.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland

Project Transitions

**October 2016:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:Jason W Mitchell
Daniel A Mullinix**Principal Investigator:**

Scott E Heatwole

Co-Investigator:

Brett T Vincent

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✓ September 2017: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. <http://techport.nasa.gov/help>

Images



Processing Computer

, Current Processing Computer
(<https://techport.nasa.gov/image/26325>)



Star Tracker Head

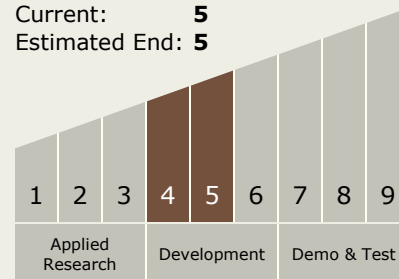
Current Star Tracker Head Design
(<https://techport.nasa.gov/image/26324>)

Project Website:

<http://aetd.gsfc.nasa.gov/>

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.4 Attitude Estimation Technologies
 - └ TX17.4.3 Attitude Estimation Sensors

Target Destination

Earth